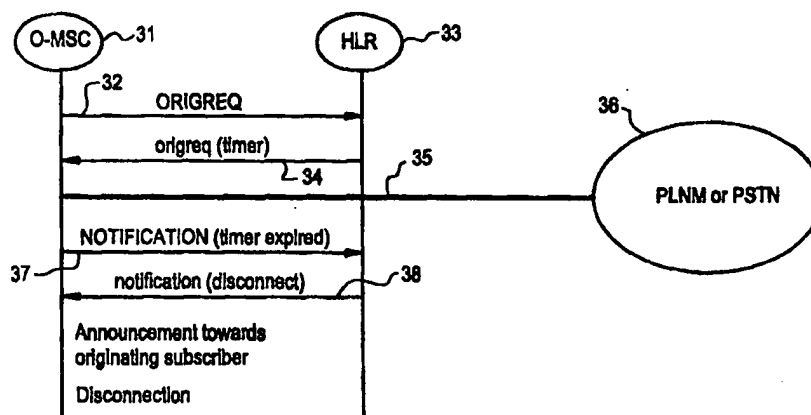


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(21) International Application Number: PCT/SE98/00520 (22) International Filing Date: 20 March 1998 (20.03.98) (30) Priority Data: 08/829,988 1 April 1997 (01.04.97) US (71) Applicant: TELEFONAKTIEBOLAGET LM ERICSSON (publ) [SE/SE]; S-126 25 Stockholm (SE). (72) Inventor: NGUYEN, Viet Anh; 6440 McLynn, Montreal, Quebec H3X 2R4 (CA). (74) Agent: ERICSSON RADIO SYSTEMS AB; Common Patent Dept., S-164 80 Stockholm (SE).		(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, GW, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG). Published <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>

(54) Title: METHOD OF LIMITING CALL CHARGES IN A RADIO TELECOMMUNICATIONS NETWORK**(57) Abstract**

A method in a radio telecommunication system of limiting charges on a subscriber's account to an available balance. The method begins by storing the available balance in the subscriber's home location register (HLR) (14, 33) and storing, in a subscriber profile in the subscriber's HLR, an instruction to monitor charges incurred by the subscriber's mobile station. The instruction includes the available balance in the subscriber's account. The HLR determines the charge rate for any call to or from the subscriber's mobile station, and converts the available balance to a time limit for the call by dividing the available balance by the charge rate. If the subscriber originates a call, the HLR (33) instructs an Originating Mobile Switching Center (O-MSC) (31) to time the call in an Origination Request Return Result message (34). If a terminating call is received for the subscriber, the HLR (14) instructs a Gateway MSC (G-MSC) (12) to time the call in a Location Request Return Result message (18). The MSC (Gateway or Originating) then times the call. If the call exceeds the time limit, the MSC sends a Notification Invoke message (21) to the HLR with an indication that the time limit expired. The HLR sends a Notification Return Result message (22) to the MSC instructing the MSC to disconnect the call.

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**METHOD OF LIMITING CALL CHARGES
IN A RADIO TELECOMMUNICATIONS NETWORK**

5 BACKGROUND OF THE INVENTION

Technical Field of the Invention

This invention relates to radio telecommunication systems and, more particularly, to a method of limiting the amount of charges that can be incurred on a cellular subscriber's account.

10 Description of Related Art

Many systems have been proposed to control fraud in cellular telecommunication systems. Some have been successful in reducing the number of fraudulent calls under certain circumstances. However, none have been totally successful, and millions of dollars of fraudulent calls still occur each year. It would be
15 advantageous to have a method of limiting the charges which a fraudulent user can make to a legitimate subscriber's account.

An additional problem faced by cellular subscribers is the control of their own charges for cellular calls. Many subscribers do not realize the amount of charges they are incurring until it is too late, and they receive a very large bill at the end of the
20 month. It would be advantageous to have a method of setting a spending limit for a subscriber, and notifying the subscriber when that spending limit has been reached.

Although there are no known prior art teachings of a solution to the aforementioned deficiency and shortcoming such as that disclosed herein, U.S. Patent Number 5,450,477 to Amarant et al. (Amarant) and European Patent Application
25 EPO 629 072 A1 to Telia AB (Telia) discuss subject matter that bears some relation to matters discussed herein. Amarant discloses a method of monitoring the connect time of a call in regards to an assigned limit to an account. When a credit card or debit card is utilized to initiate a call, the card is validated and the available balance in the account is determined. Based upon the available balance in the account, a
30 time limit for the call is established. If the call exceeds the time limit, the system operator terminates the call. When a call terminates, the billing information is sent

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to a network database that subtracts the charges from the balance of the account. Amarant primarily teaches an algorithm to calculate the debit.

5 Amarant, however, describes a method that is suitable for a landline telephone system. Amarant does not teach or suggest a method of establishing a debit limit in a cellular telecommunication system, communicating the necessary information between nodes in the cellular system, and disconnecting calls that exceed the established debit limit.

10 Telia discloses an arrangement in a telephone system for controlling debiting of services. Telia briefly describes a system that is suitable for a landline telephone system, but does not provide any details about how such a system would be implemented. In addition, Telia does not teach or suggest a method of establishing a debit limit in a cellular telecommunication system, communicating the necessary information between nodes in the cellular system, and disconnecting calls that exceed the established debit limit.

15 Review of each of the foregoing references reveals no disclosure or suggestion of a system or method such as that described and claimed herein.

In order to overcome the disadvantage of existing solutions, it would be advantageous to have a method of limiting the charges on a cellular subscriber's account to a preset limit. Such a method would limit fraud if a fraudulent user attempts to make calls that are too lengthy or too expensive. In addition, the method would enable cellular subscribers to set their own spending limits and, for example, to end a call when the toll reaches the subscriber's limit. The present invention provides such a method.

25 SUMMARY OF THE INVENTION

In one aspect, the present invention is a method of controlling fraud if a fraudulent user attempts to utilize a legitimate subscriber's mobile station to make calls that are too lengthy or too expensive. In addition, the present invention enables cellular subscribers to set their own spending limits and, for example, to end a call when the toll reaches the subscriber's limit.

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Thus, in one aspect, the present invention is a method in a radio telecommunication system of limiting charges on a subscriber's account to an available balance. The method begins by storing the available balance in the subscriber's home location register (HLR) and storing, in a subscriber profile in the subscriber's HLR, an instruction to monitor charges incurred by the subscriber's mobile station. This is followed by informing the HLR that the subscriber has originated a call. The HLR determines the parameters of the call and converts the available ~~balance to a time limit~~ for the call. This is followed by instructing an Originating Mobile Switching Center (O-MSC) to time the call, and disconnecting the call if the call exceeds the time limit.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be better understood and its numerous objects and advantages will become more apparent to those skilled in the art by reference to the following drawing, in conjunction with the accompanying specification, in which:

FIG. 1 is a message signaling diagram illustrating the flow of messages between affected nodes of a radio telecommunications network when the present invention is implemented for calls terminating at a mobile station operating in the network;

FIG. 2 is a message signaling diagram illustrating the flow of messages between affected nodes of a radio telecommunications network when the present invention is implemented for calls originating at a mobile station operating in the network; and

FIGS. 3A and 3B are a flow chart illustrating the steps of the method of the present invention when the present invention is implemented for calls originating at a mobile station operating in the network.

DETAILED DESCRIPTION OF EMBODIMENTS

The present invention defines the signaling interface between nodes in a radio telecommunications network required to implement a method of limiting the charges on a subscriber's account to a preset limit. The method of the present invention

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limits fraud if a fraudulent user attempts to make calls that are too lengthy or too expensive. In addition, the method enables subscribers to set their own spending limits and, for example, to end a call when the toll reaches the subscriber's limit.

In the present invention, the operator or the subscriber may request that call charges or call lengths from the subscriber's mobile station be monitored. This information is stored in the subscriber profile (subscriber category) in the subscriber's home location register (HLR). A subscriber may request the monitoring service to ensure that he does not exceed a predetermined debit limit. The operator may request the monitoring service whenever fraudulent usage is suspected. Any call originated from a subscriber's mobile station may be a fraudulent call. When the dialed digits reach the HLR, an analysis of the dialed digits indicates whether the call is a local call or a long distance call. If it is a long distance call, it is more likely that the call is a target of fraud. Therefore, the method of the present invention may include a step that activates call monitoring only if the dialed digits analysis indicates that the call is a long distance call.

A timer in the Gateway Mobile Switching Center (G-MSC) determines whether the call exceeds a predetermined length which is calculated based on the available balance in the subscriber's account. If so, the call is disconnected. The system may optionally play an announcement notifying the subscriber of the reason that the call was disconnected. The length of the call may be varied, depending on the applicable charge rate. For example, domestic long distance calls may be limited to 30 minutes while international long distance calls may be limited to 10 minutes.

FIG. 1 is a message signaling diagram illustrating the flow of messages between affected nodes of a radio telecommunications network when the present invention is implemented for calls terminating at a mobile station operating in the network. A call 11 for the mobile station is first received in a Gateway Mobile Switching Center (G-MSC) 12. The G-MSC sends a Location Request (LOCREQ) Invoke message 13 to the subscriber's Home Location Register (HLR) 14. The HLR sends a Routing Request (ROUTEREQ) Invoke message 15 to the Visited Location Register/Mobile Switching Center (V-MSC) 16 where the mobile station

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is operating. In systems which support paging-before-routing, the V-MSC then pages the mobile station and receives a page response.

Whether paged or not, the V-MSC then sends a Routing Request (routereq) Return Result message 17 to the HLR 14. The HLR checks the subscriber profile to determine whether the operator or the subscriber has requested that call charges or call lengths from the subscriber's mobile station be monitored. If call monitoring is activated, the HLR includes a new parameter (timer) in the Location Request (locreq) Return Result message 18 commanding the G-MSC to monitor the length of the call, and informing the G-MSC of the allowable length of the call. The operator or the subscriber may enter a debit limit, and the HLR calculates the allowable length of the call. The method illustrated in U.S. Patent No. 5,450,477 to Amarant et al., which is hereby incorporated by reference, may be utilized as a suitable method of converting a debit limit to time and vice versa. The call is then set up at 19 and monitored by the G-MSC 12.

If the time period expires before the end of the call, the G-MSC 12 sends a Notification Invoke message 21 to the HLR 14 indicating that the timer has expired. The HLR sends a notification Return Result message 22 to the G-MSC ordering the G-MSC to disconnect the call. The Notification Invoke message 21 and the notification Return Result message 22 are new IS-41 messages. Thereafter, an announcement may be played to the mobile subscriber with the reason for the disconnection. This announcement is currently played by the G-MSC 12, and the call is then disconnected.

FIG. 2 is a message signaling diagram illustrating the flow of messages between affected nodes of a radio telecommunications network when the present invention is implemented for calls originating at a mobile station operating in the network. When a subscriber operating a mobile station in an originating MSC (O-MSC) 31 originates a call, an Origination Request (ORIGREQ) Invoke message 32 is sent to the subscriber's HLR 33. The HLR checks the subscriber profile to determine whether the operator or the subscriber has requested that call charges or call lengths from the subscriber's mobile station be monitored. If call monitoring is activated, the HLR includes a new parameter (timer) in the Origination Request

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(origreq) Return Result message 34 commanding the O-MSC 31 to monitor the length of the call, and informing the O-MSC of the allowable call length. The operator or the subscriber may enter a debit limit, and the HLR calculates the allowable length of the call. The call is then set up at 35 and monitored by the O-MSC 31. The call may be to another mobile station operating within the Public Land Mobile Network (PLMN) or the Public Switched Telephone Network (PSTN) 36.

If the time period expires before the end of the call, the O-MSC 31 sends a Notification Invoke message 37 to the HLR 33 indicating that the timer has expired. The HLR sends a notification Return Result message 38 to the O-MSC ordering the O-MSC to disconnect the call. The Notification Invoke message 37 and the notification Return Result message 38 are new IS-41 messages. Thereafter, an announcement may be played to the mobile subscriber with the reason for the disconnection. This announcement is currently played by the O-MSC 31, and the call is then disconnected.

FIG. 3 is a flow chart illustrating the steps of the method of the present invention when the present invention is implemented for calls originating at a mobile station operating in the network. The process begins at step 41 where it is determined whether the subscriber desires to set a debit limit for his account. If not, the process ends at 42. If the subscriber desires to set a debit limit, the process moves to step 43 where the subscriber requests that call charges from his mobile station be monitored. The subscriber also enters the allowable debit limit.

The process may also begin at step 44 where it is determined whether fraudulent usage of the subscriber's mobile station is suspected. If not, the process ends at 45. If fraudulent usage is suspected, the process moves to step 43 where the system operator requests that call charges from the subscriber's mobile station be monitored. The operator also enters an allowable debit limit.

At step 46, the subscriber's HLR stores an instruction for call monitoring in the subscriber's profile (category). The instruction includes the allowable debit limit. At step 47, the subscriber originates a call. The operator may desire to implement the present invention only for long distance calls, which are more likely

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to be fraudulent. Therefore, at this point, the process may optionally determine whether the call is a long distance call. This may be accomplished in the HLR through an analysis of the dialed digits. If the call is not a long distance call, the process ends at 49.

5 If the call is determined to be a long distance call (or if optional step 48 is not implemented), the process moves to step 51 where the HLR checks the subscriber profile for the call monitoring instruction and allowable debit limit. At step 52, the HLR determines a charge rate for the call and converts the available balance in the subscriber's account to a time limit for the call. The charge rate may
10 be determined from the time of day, the day of the week, the origin and the destination for the call, and applicable charge rate tables. The time limit for the call may be calculated by dividing the available balance by the charge rate. The process then moves to FIG. 3B.

 The process continues at step 53 where the HLR provides the time limit to
15 the originating MSC (O-MSC), and instructs the O-MSC to time the call. At step 54, the O-MSC times the call, and at 55, it is determined, while the call is in progress, whether the call is exceeding the time limit. If not, and the call ends before the time limit is exceeded, the process moves to step 56 where the O-MSC informs the HLR of the time utilized for the call. The HLR converts the time
20 utilized to a debit charge at 57, and updates the available balance in the subscriber profile at 58. The process then returns to step 47 and waits for the subscriber to originate another call.

 If, however, the call exceeds the time limit at step 55, the process moves to step 61 where the O-MSC informs the HLR that the time limit has expired. The
25 HLR instructs the O-MSC to disconnect the call at 62. At step 63, the O-MSC disconnects the call. An announcement may be played to the subscriber at 64 notifying him of the reason for the disconnection.

 It is thus believed that the operation and construction of the present invention will be apparent from the foregoing description. While the method, apparatus and
30 system shown and described has been characterized as being preferred, it will be readily apparent that various changes and modifications could be made therein

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without departing from the spirit and scope of the invention as defined in the following claims.

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WHAT IS CLAIMED IS:

1. In a radio telecommunications system, a method of limiting charges on a subscriber's account to an available balance, said method comprising the steps of:

5 storing said available balance in the subscriber's home location register (HLR);

storing, in a subscriber profile in the subscriber's HLR, an instruction to monitor charges incurred by the subscriber's mobile station;

informing said HLR that the subscriber has originated a call;

10 converting said available balance to a time limit for said call;

instructing an Originating Mobile Switching Center (O-MSC) to time said call; and

disconnecting said call if the call exceeds the time limit.

15 2. The method of claim 1 further comprising, before the step of storing the instruction to monitor charges, the step of instructing said radio telecommunications system to monitor charges incurred by the subscriber's mobile station, said instructing step being performed by the system operator when there is an indication of fraudulent usage of the subscriber's mobile station.

20 3. The method of claim 2 wherein the step of instructing said radio telecommunications system to monitor charges includes the steps of:

determining whether said call is a long distance call; and

25 instructing said radio telecommunications system to monitor charges upon determining that said call is a long distance call.

30 4. The method of claim 1 further comprising, before the step of storing the instruction to monitor charges, the step of instructing said radio telecommunications system to monitor charges incurred by the subscriber's mobile station, said instructing step being performed by the subscriber when the subscriber desires to set a debit limit for calls from the subscriber's mobile station.

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5. The method of claim 1 wherein the step of converting said available balance to a time limit for said call includes the steps of:

determining the charge rate for said call; and

5 dividing the available balance by the determined charge rate.

6. The method of claim 5 wherein the step of determining the charge rate for said call includes the steps of:

determining the time of day;

10 determining the day of the week;

determining an origin and a destination for the call; and

applying an applicable charge rate.

7. The method of claim 5 wherein the step of instructing the O-MSC to
15 time the call includes sending a message from the HLR to the O-MSC instructing the O-MSC to time the call.

8. The method of claim 7 wherein the step of sending a message from the HLR to the O-MSC instructing the O-MSC to time the call includes sending an
20 instruction to time the call in an Origination Request Return Result message.

9. The method of claim 7 further comprising the step of utilizing a timer in said O-MSC to time the call while the call is in progress.

25 10. The method of claim 9 wherein the step of disconnecting said call if the call exceeds the time limit includes the steps of:

sending a message from the O-MSC to the HLR notifying the HLR that the time limit has expired; and

30 sending a message from the HLR to the O-MSC instructing the O-MSC to disconnect the call.

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11. The method of claim 10 wherein the step of sending a message from the O-MSC to the HLR notifying the HLR that the time limit has expired includes notifying the HLR that the time limit has expired in a Notification Invoke message.

5 12. The method of claim 10 wherein the step of sending a message from the HLR to the O-MSC instructing the O-MSC to disconnect the call includes sending an instruction in a Notification Return Result message.

10 13. The method of claim 1 further comprising the step of sending an announcement to the subscriber telling the subscriber why the call was disconnected.

14. In a radio telecommunications system, a method of limiting charges on a subscriber's account to an available balance, said method comprising the steps of:

15 storing said available balance in the subscriber's home location register (HLR);

 storing, in a subscriber profile in the subscriber's HLR, an instruction to monitor charges incurred by the subscriber's mobile station;

20 informing said HLR that a terminating call has been received for the subscriber;

 converting said available balance to a time limit for said call;

 instructing a Gateway Mobile Switching Center (G-MSC) to time said call;

and

 disconnecting said call if the call exceeds the time limit.

25

15. The method of claim 14 wherein the step of converting said available balance to a time limit for said call includes the steps of:

 determining the charge rate for said call; and

 dividing the available balance by the determined charge rate.

30

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16. The method of claim 15 wherein the step of determining the charge rate for said call includes the steps of:

determining the time of day;

determining the day of the week;

5 determining an origin and a destination for the call;

determining what portion of the charge the subscriber is responsible for; and

applying an applicable charge rate.

17. The method of claim 15 wherein the step of instructing the G-MSC
10 to time the call includes sending a message from the HLR to the G-MSC instructing the G-MSC to time the call.

18. The method of claim 17 wherein the step of sending a message from the HLR to the G-MSC instructing the G-MSC to time the call includes sending an
15 instruction to time the call in a Location Request Return Result message.

19. The method of claim 17 further comprising the step of utilizing a timer in said G-MSC to time the call while the call is in progress.

20. The method of claim 19 wherein the step of disconnecting said call
20 if the call exceeds the time limit includes the steps of:

sending a message from the G-MSC to the HLR notifying the HLR that the time limit has expired; and

25 sending a message from the HLR to the G-MSC instructing the G-MSC to disconnect the call.

21. The method of claim 20 wherein the step of sending a message from the G-MSC to the HLR notifying the HLR that the time limit has expired includes notifying the HLR that the time limit has expired in a Notification Invoke message.
30

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22. The method of claim 20 wherein the step of sending a message from the HLR to the O-MSC instructing the O-MSC to disconnect the call includes sending an instruction in a Notification Return Result message.

5 23. The method of claim 14 further comprising the step of sending an announcement to the subscriber telling the subscriber why the call was disconnected.

10

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FIG. 1

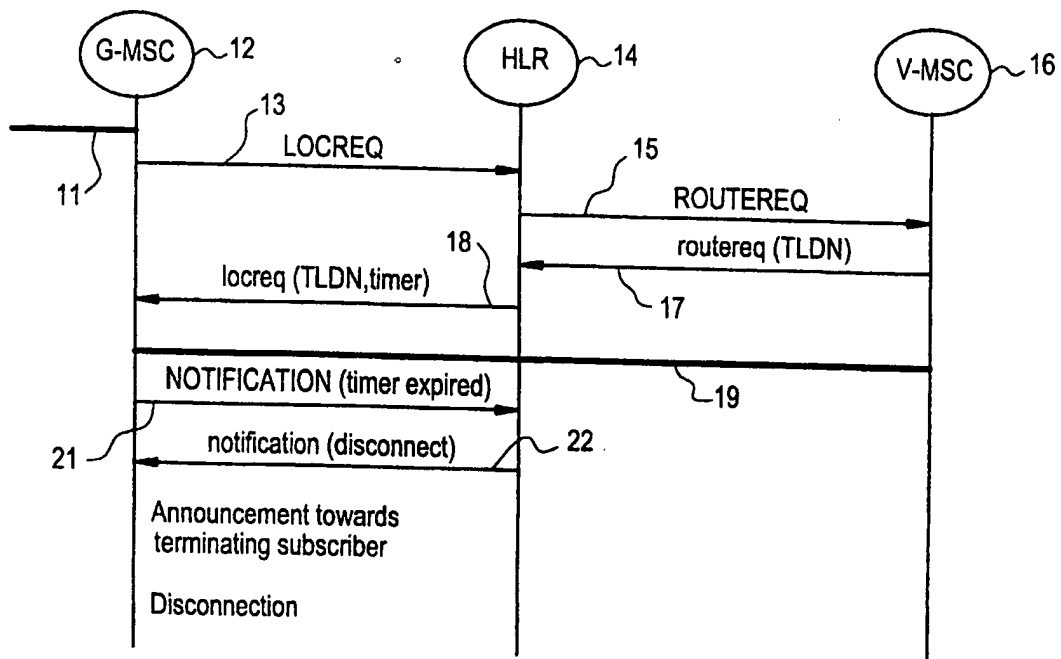
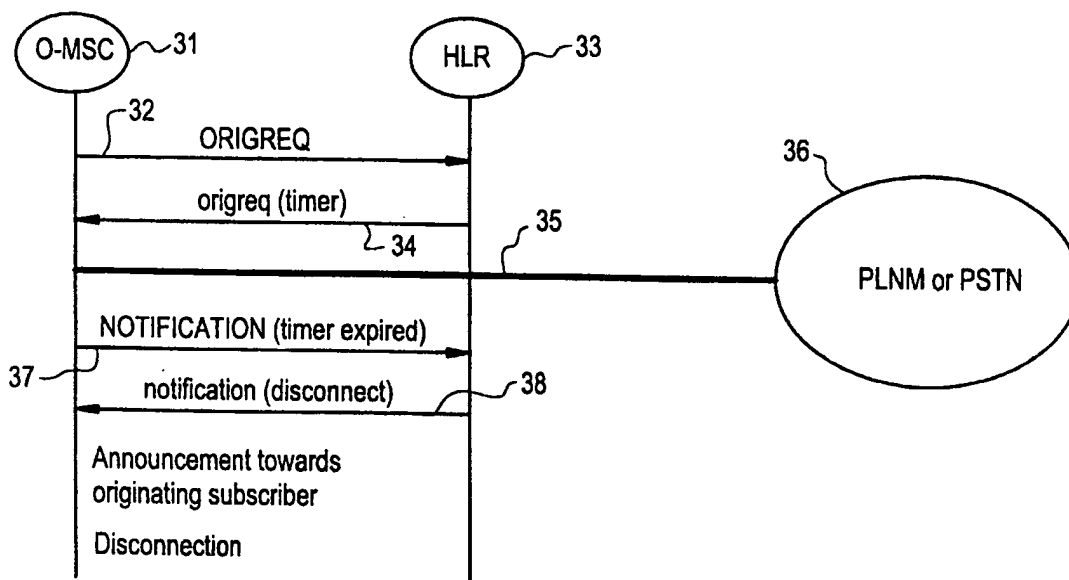


FIG. 2



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FIG. 3A

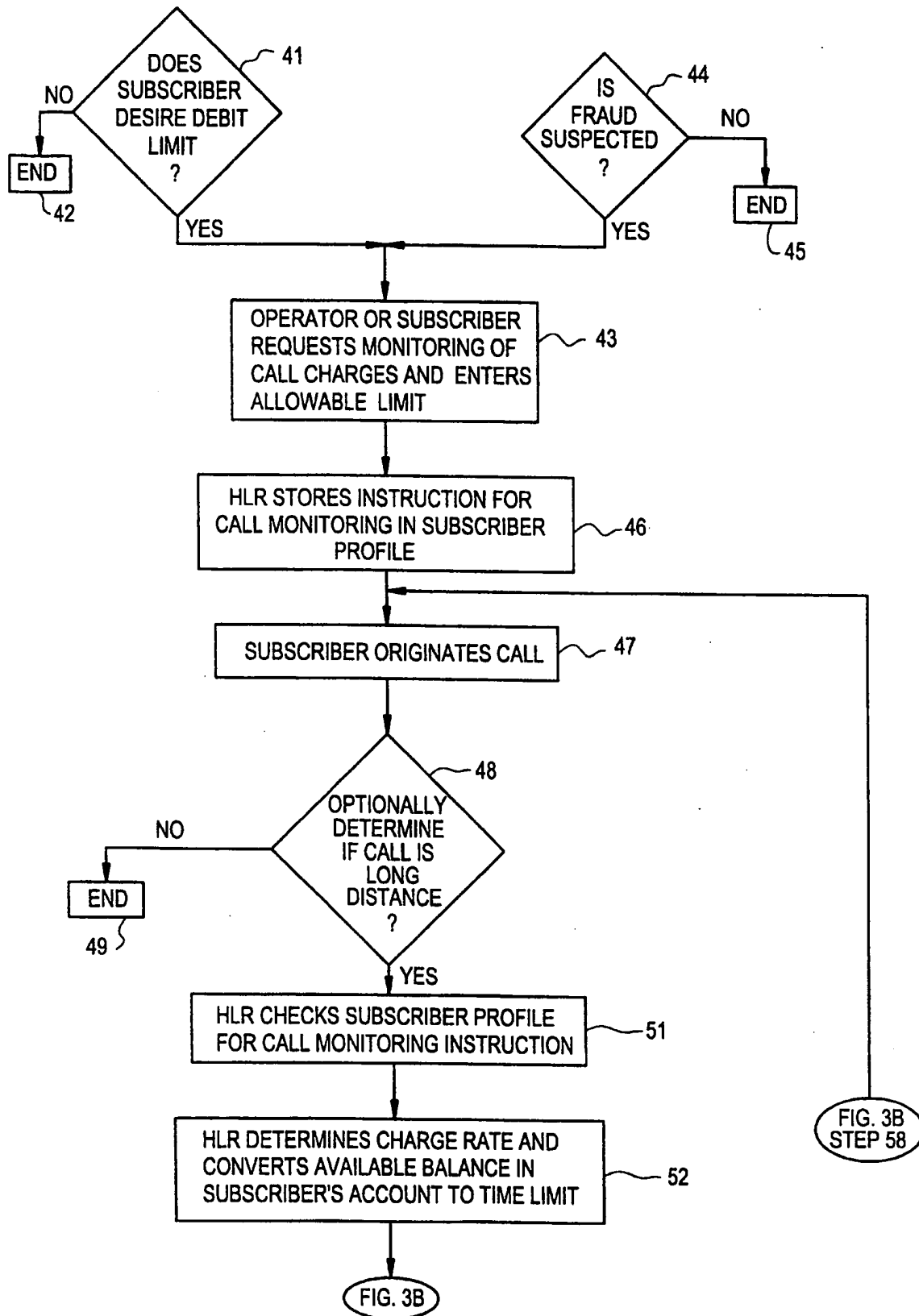
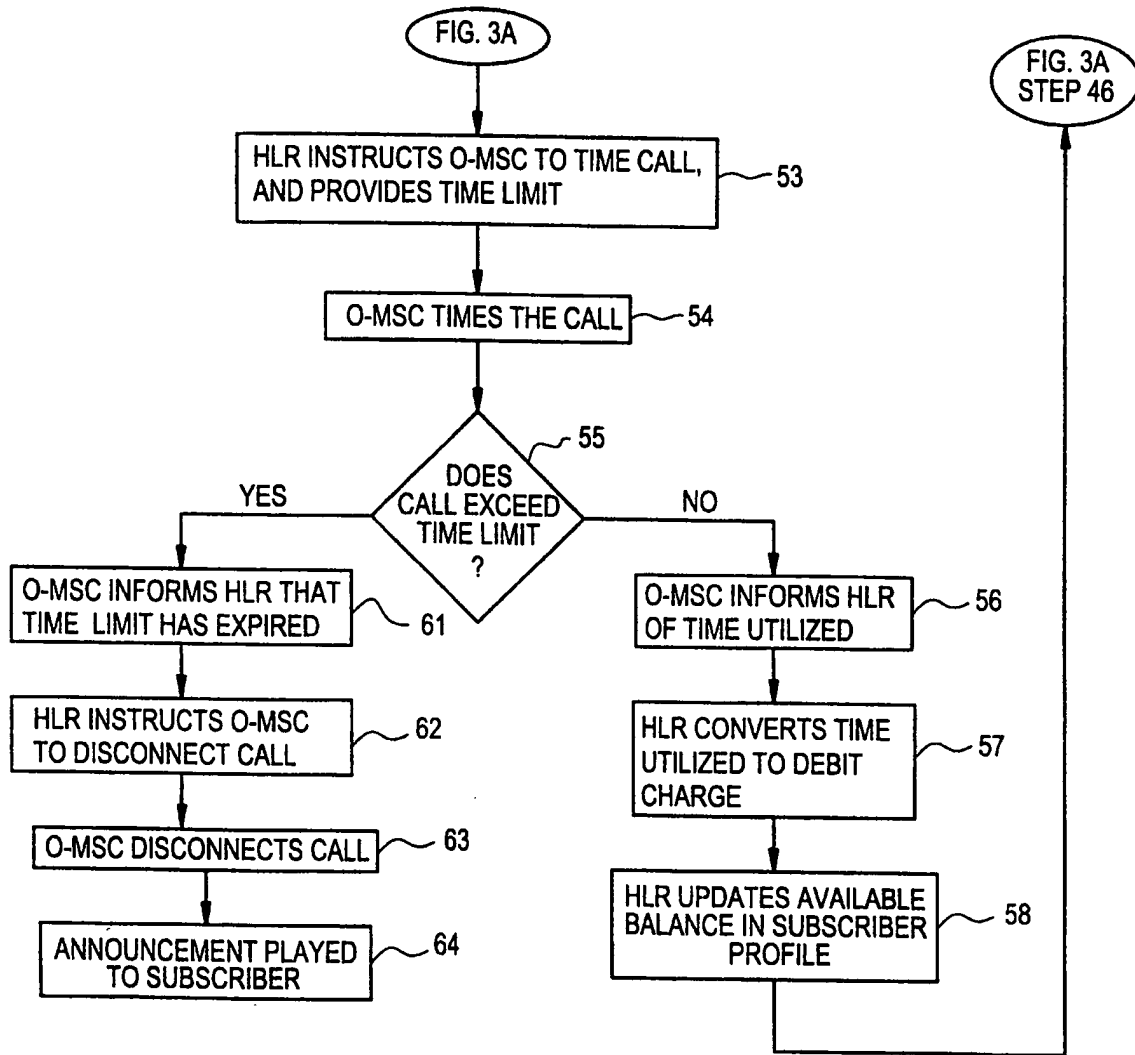


FIG. 3B



International Application No
PCT/SE 98/00520

According to International Patent Classification(IPC) or to both national classification and IPC

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H04M H04Q

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 746 135 A (SIEMENS AG) 4 December 1996	1-3, 5-7, 9, 10, 13-17, 19, 20, 23
A	see column 1, line 1 - column 2, line 59 see column 3, line 42 - column 6, line 10 see claims 1, 2	8, 11, 12, 18, 21, 22
A	WO 93 12606 A (CELLULAR TECH SERVICES) 24 June 1993	1-3, 6, 10, 13, 14, 16, 20, 23
	see page 2, line 15 - page 4, line 14 see page 18, line 5 - page 19, line 22 see claims 1-5, 9-11	

☒ Patent family members are listed in annex.

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15/09/1998

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
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